THE MEXICAN BEAN BEETLE IN THE EAST

AND ITS CONTROL

FARMERS' BULLETIN No. 1624
U. S. DEPARTMENT OF AGRICULTURE

THE MEXICAN BEAN BEETLE in its range of distribution is the most serious insect enemy of beans in the United States. It was first found in the East in Alabama in 1920, and now infests most of the States east of the Mississippi River and bordering areas to the west.

The adult is a copper-colored beetle bearing 16 black spots on its back; it is about one-fourth of an inch long. The larva is orange colored and is frequently described as "fuzzy."

This insect feeds on the plants of all kinds of edible beans. The principal injury is done to the foliage.

For the control of this pest, sprays or dusts containing rotenone prepared from derris or cube are most satisfactory.

Infested fields should be plowed under as soon as the crop is off, and the grower should not plant more beans than can be properly treated.

This bulletin is a revision of and supersedes Farmers' Bulletin No. 1407, The Mexican Bean Beetle in the East.

Washington, D. C.

Issued March 1930
Revised February 1948

THE MEXICAN BEAN BEETLE IN THE EAST AND ITS CONTROL

By NEALE F. HOWARD, LOYD W. BRANNON, and HORATIO C. MASON, *entomologists, Division of Truck Crop and Garden Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration.*

CONTENTS

THE MEXICAN BEAN BEETLE[1] is the most serious insect enemy of beans in those parts of the United States which it inhabits. It has long been present in the Southwestern States. In 1920 it was discovered at Birmingham and Blocton, Ala. Since that time the pest has spread throughout the greater part of the territory east of the Mississippi River as well as bordering areas to the west.

APPEARANCE OF INSECT AND NATURE OF DAMAGE

The Mexican bean beetle is a copper-colored, round-backed beetle with 16 black spots on its back. It is about one-fourth of an inch long and about one-fifth of an inch wide (fig. 1, *d*). The beetle resembles somewhat some of the native beneficial ladybirds.

The larva or immature form is orange-colored, varies in length from about one-twentieth of an inch when young to about one-third of an inch when full grown, and is covered with branched spines, which give it a fuzzy appearance.

Injury done to the bean plant by the young and adult of the Mexican bean beetle is different from that caused by other insects which feed

[1] *Epilachna varivestis* Muls. (formerly *E. corrupta* Muls.); order Coleoptera, family Coccinellidae.

768621°—48

Figure 1.—Eggs *(a)*, larvae *(b)*, pupa *(c)*, and adults *(d)* of the Mexican bean beetle in natural position on the under surface of a bean leaf. Enlarged three diameters.

on the beans. The adult, feeding from below, eats ragged areas in the lower surface of the leaf, but often cuts through the upper surface, giving the foliage a lacelike appearance (fig. 2). The larvae also feed on the under surface of the leaf, but do not cut through the upper surface. The lower tissue is scraped up and compressed by the mouth parts as the juices are swallowed. The solid material is left on the leaf in small windrows or strips, so that the result is a peculiar network characteristic of the work of this insect (fig. 3).

Although the leaves are attacked first, all parts of the plant above the ground may be fed upon by both beetle and larva. When the insects are numerous, an injured plant presents the appearance of being completely dried out (fig. 4). After destroying the leaves, the insect will attack the pods and even the stems.

When the beetles are abundant, a bean crop may be completely destroyed (fig. 5).

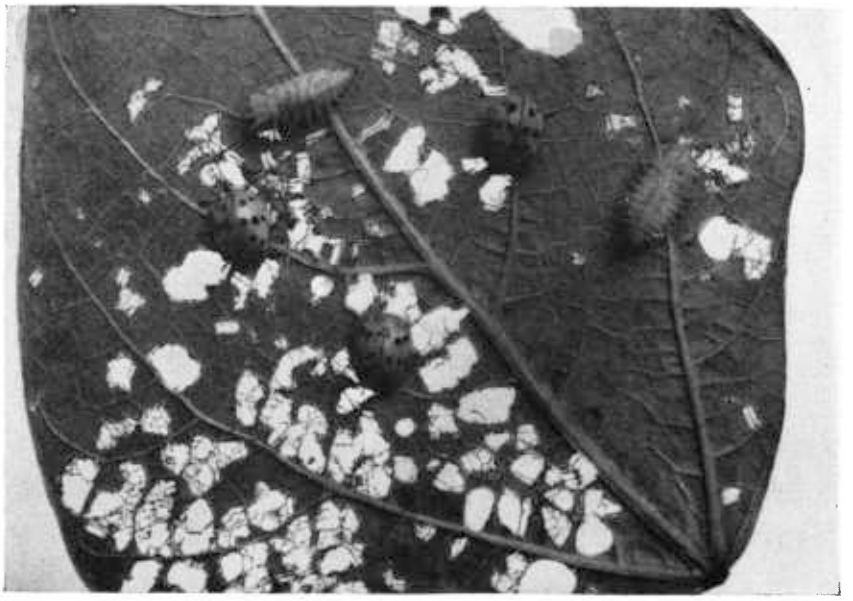

Figure 2.—Adults and larvae of the Mexican bean beetle on the under side of a bean leaf showing areas eaten by the adults. Enlarged two diameters.

THE DIFFERENT STAGES

The Mexican bean beetle reproduces by means of eggs deposited in clusters of from 40 to 60 on the lower surface of a leaf. Figure 1 illustrates the different stages of the insect. The eggs are orange yellow. The young or larva, when first hatched, is about one-twentieth of an inch long, and a few hours after hatching it begins feeding. As it grows, the larva molts or sheds its skin. When full grown it is about one-third of an inch long and about one-half as wide. The full-grown larva attaches itself to the under surface of the bean leaf upon which

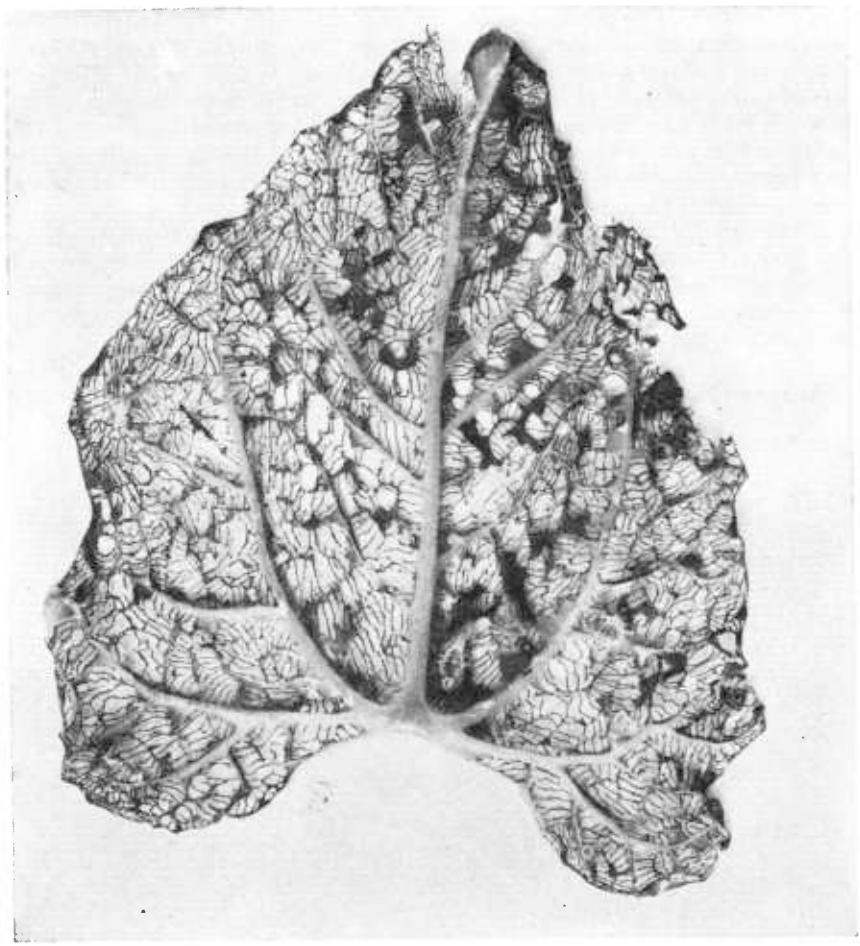

Figure 3.—Results of the feeding of larvae of the Mexican bean beetle on a bean leaf. Slightly enlarged.

it has been feeding or to some other leaf, weed, or nearby object, and becomes shorter but larger around the body preparatory to pupation.

It then changes to the pupa or inactive stage, which is orange colored, and is attached to the leaf or other object by means of the fourth larval skin. When the beetle develops from the pupal stage it is light-lemon colored and shows no black spots upon the wing covers. The spots soon appear, however, and the beetle gradually becomes darker until after a week or 10 days it has become copper colored. Old beetles and those that have lived through the winter are darker in color, and the spots are less distinct.

REGIONS IN WHICH THIS BEETLE IS FOUND

Probably the Mexican bean beetle came originally from Mexico. It has been known in the western part of the United States since about

Figure 4.—Unsprayed beans to the left of stake; sprayed beans to the right.

1850. It is now known to exist in Arizona, New Mexico, Colorado, Wyoming, and Utah, and has also been recorded from western Texas, western Nebraska, and western South Dakota. An isolated infestation was found in Ventura County, Calif., in 1946.

In the eastern United States the Mexican bean beetle was first discovered in Alabama in 1920. Since then it has spread to most of

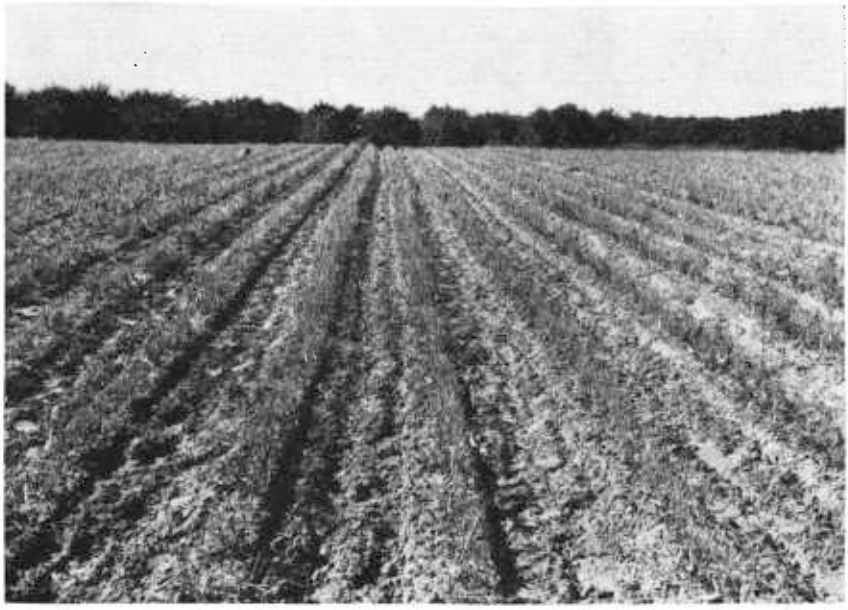

Figure 5.—A field of beans destroyed by the Mexican bean beetle.

the important bean-growing districts of the States east of the Mississippi River, as shown in figure 6, page 6. It is also reported to be a pest in eastern Iowa, particularly in Scott and Muscatine Counties. During 1947 infestations that were apparently isolated were reported by State authorities near Blaine in Aroostook County, Maine, and near Madison, in Dane County, Wis. The worst damage has occurred in the foothills and valleys of the Allegheny Mountains and along the Atlantic coast from South Carolina to New York.

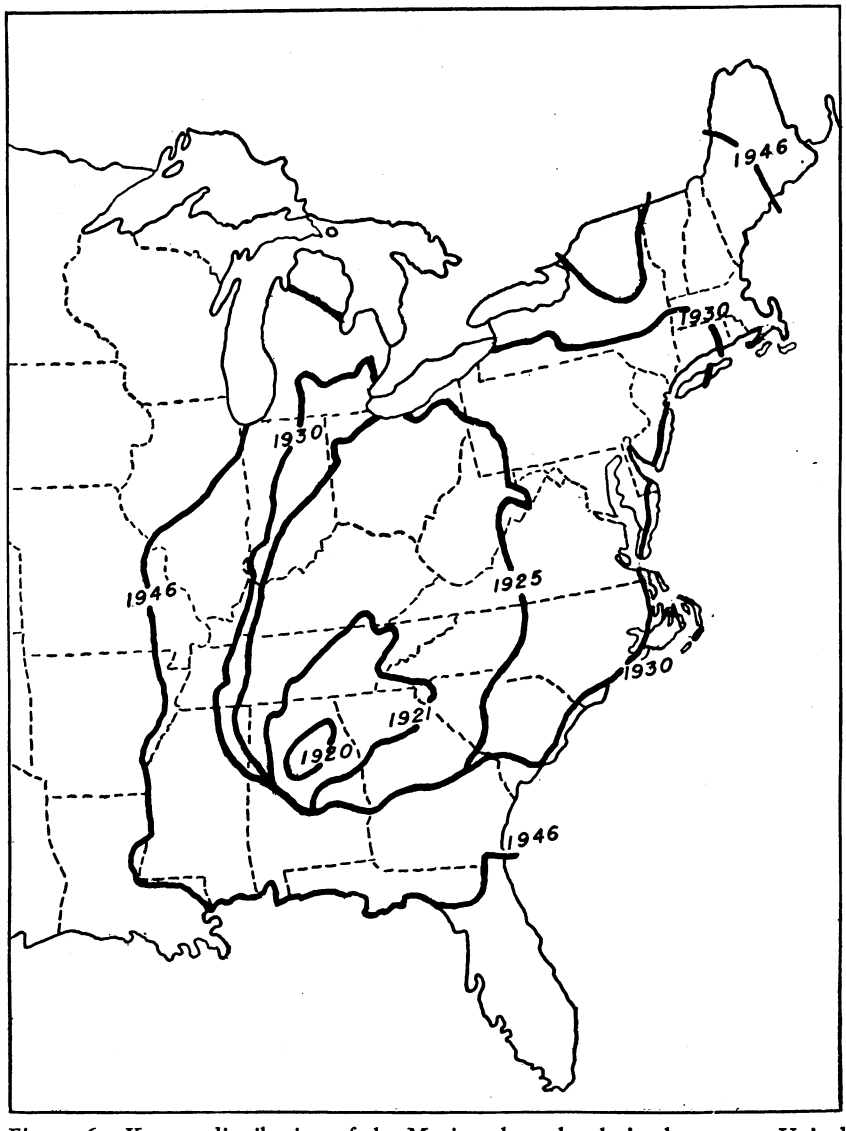

Figure 6.—Known distribution of the Mexican bean beetle in the eastern United States. The heavy lines represent the approximate boundaries of the infested territory for 1920, 1921, 1925, 1930, and 1946.

LIFE HISTORY AND HABITS

The beetles begin to leave their winter quarters in the spring. In the South they first appear in the bean fields late in March or early in April, while in southwestern New York they do not appear until June. At intermediate points they appear on different dates, depending on the location. In some places they are present when early beans are still small; in others, when the first blossoms appear. After feeding, usually for a week or 10 days, the females deposit their eggs.

Eggs laid early in the spring hatch in 10 to 14 days, as a rule. As the weather becomes warmer the eggs hatch in less time, in 6 or even 5 days. The young that hatch in the early part of the season develop rather slowly and may require 5 weeks to complete their growth. Later in the season, however, the development of the larvae requires an average of about 20 days. The pupal period during summer averages about 7 days. Thus the total period of development from egg to beetle averages about 33 days in midsummer.

Within 2 weeks after emerging from the pupa, the female beetle deposits eggs. Some beetles that overwintered may live for 3 months, but the majority die within 1 month. The insect reproduces rapidly; and by the time the early crop of beans has matured, the beetle has often become abundant. A maximum of three or even four generations of the beetle may occur in the Southern States, but in the North only one generation or one and a partial second are produced. In the Southwest one generation is the rule, but in some sections a second generation occurs.

The ability of the beetle to reproduce rapidly under favorable conditions is remarkable. A female may deposit an egg mass every 2 or 3 days. As many as 1,669 eggs have been deposited by one female, while the average number observed is 459.

Late in summer and early in fall the first beetles seek winter quarters, and others follow until about the first frost, at which time practically all beetles have left the fields. All stages are present in the field from spring until frost in the fall, but eggs and larvae may become scarce late in the summer and early in the fall.

The spread from the original point of infestation in northern Alabama has been accomplished mainly by flight, with the assistance of prevailing winds. The beetle is sluggish in its movements, but is a comparatively strong flier and may fly many miles. Marked beetles have, within 2 days, been captured 5 miles from the point where they were liberated. During 1921 a spread of over 200 miles northward occurred, and in 1922 a spread of over 100 miles, and the average maximum distance covered in the period 1921 to 1924 was 150 miles a year.

HIBERNATION

Only the adult beetle lives through the winter. In northern Alabama it hibernates preferably in woodlands near bean fields, where it often collects in small colonies. As many as 400 beetles have been found in one group covering an area of about 3 square feet, under pine needles and oak leaves on a well-drained woodland hillside near

768621°—48——2

cultivated bean fields (fig. 7). Some may remain in the bean fields and others about the field or garden under rubbish and plant remnants and along fence rows and in uncultivated land. In many sections of the North and East the majority of the beetles hibernate in such places. The beetles have been found there in the winter as far as three-fourths of a mile from the nearest bean field, but the majority stay within a quarter of a mile. In the West the beetle may fly many miles to hibernate. In the Southeastern States complete

Figure 7.—Hibernation quarters for the Mexican bean beetle: *A*, Forest in which hibernating beetles were found, and *B*, litter and beetles found under brush in foreground of *A*.

dormancy is not continuous throughout the entire winter, since the beetles move about on warm days.

FOOD PLANTS

The Mexican bean beetle is primarily an edible-bean pest, preferring the common bean, such as snap (green or string), kidney, pinto, navy, and lima beans to other kinds. Its second choice of food is beggarweed or beggartick,[2] which grows wild generally throughout the Eastern States and is cultivated for hay in some sections. The insect can reproduce successfully on cowpeas and soybeans, but injury to these crops is unusual.

NATURAL AGENCIES OF CONTROL

No internal parasite of the Mexican bean beetle had been recorded until 1922, when two native species of flies [3] were found to parasitize the insect in rare instances in northern Alabama. They have never become abundant enough to be of any value.

A number of predaceous insects feed on the eggs and young larvae, and in some cases on the older larvae, pupae, and adults of the Mexican bean beetle. The most common of these in the Southeastern States is the spotted ladybird,[4] which feeds sparingly on the eggs and young larvae. The "anchor bug" [5] in both immature and adult stages preys on larvae, pupae, and adults of this bean beetle. The spined soldier bug [6] attacks all stages. A few other bugs and a few beneficial ladybird beetles feed on different stages of the bean beetle, but are of little importance. The adult bean beetle at times feeds on its own eggs.

A tachinid fly parasite [7] of this bean beetle is prevalent in some sections of Mexico, and efforts have been made to introduce the species into the United States but without success.

In the West the injury done by this pest to the bean crop has varied from year to year. This has been more or less true in the East, but in many sections the beetle has been sufficiently numerous every year to do serious injury and make the use of control measures necessary. No explanation for this fluctuation can be made other than that weather conditions are probably the most important factors. Heavy rains during the spring and summer are detrimental to the insect, and larvae and adults often become mired in the soil. Extreme droughts and hot weather have been observed to act as a material check, especially if the beans suffer from lack of water. Temperature and moisture during the winter are important, and survival during the winter depends largely on these factors.

The intense heat of bright sunlight during hot periods in summer kills many larvae and pupae. When dry weather causes the bean

---

[2] *Desmodium tortuosum* (Sw.) DC.; *D. canescens* (L.) DC.
[3] *Phorocera claripennis* Macq.; *Helicobia rapax* (Walk.) (=*helicis* Towns.).
[4] *Coleomegilla maculata lengi* Timb.
[5] *Stiretrus anchorago* (F.).
[6] *Podisus maculiventris* (Say).
[7] *Paradexodes epilachnae* Ald.

leaves to turn upward, or when varieties of beans which have this habit are grown, many egg masses, larvae, and pupae are exposed to the heat and killed.

CONTROL MEASURES

Where the Mexican bean beetle thrives, control measures are essential. The best known remedy for the protection of beans is a spray or dust containing the ground roots of derris or cube, the chief toxic ingredient of which is rotenone. A large number of other remedies have been tested extensively, but none of them have given good results so consistently without injury to the plant. Rotenone sprays or dusts may be applied to beans after the pods have formed, since they leave no harmful residues on the market product when applied at the recommended dosages.

SPRAYS

A spray containing 1¼ pounds of derris or cube powder (rotenone content 5 percent) to 50 gallons of water is recommended. Such a spray contains 0.015 percent of rotenone. Wet the powder thoroughly with a small quantity of water, and then pour it through a fine strainer into the water in the spray tank. No spreader or sticker is necessary.

For making smaller quantities of spray, use at the rate of 1¼ ounces (8 level tablespoonfuls or half a cupful) of powder to 3 gallons of water or ½ ounce (3 level tablespoonfuls) to 1 gallon.

The quantity of derris or cube powder required to prepare 50 gallons of a spray containing 0.015 percent of rotenone is calculated by dividing 0.015 by the percentage of rotenone in the powder and multiplying the result by 417, which is the weight in pounds of 50 gallons of water. Thus, if the rotenone content of the powder is 4 percent, the quantity to be used is $\left(\frac{0.015}{4}\right) 417=1.56$ pounds.

Do not use for making up sprays the ready-mixed or home-mixed dusts containing 0.5 or 0.75 percent of rotenone, which are intended for dusting and contain other materials. Only the undiluted ground derris or cube root should be used for making spray mixtures.

Bush varieties of beans require from 100 to 125 gallons of spray to the acre, or from 1½ to 2 quarts on 50 feet of row. Pole varieties have heavier foliage and therefore require larger quantities.

Sulfur is of value for controlling certain insects and diseases (see Dusts), and where it is deemed necessary wettable sulfur may be added to any of the sprays mentioned above at the rate of 2 pounds to 50 gallons of water.

How To Apply the Spray

It is important that the sprays recommended in this bulletin for Mexican bean beetle control be applied on the under sides of the leaves, because the adults and larvae of this pest feed first on that part of the bean plant. Care should be taken to cover thoroughly with the insecticide the under sides of the leaves on all of the plants. Spraying only the upper surfaces of the leaves is practically useless and will not control the bean beetle.

Spray Machines

The grower of 4 or 5 acres of beans, or more, should use a tractor or horsedrawn power or traction spray machine, which will spray three to eight rows at a time. There is no entirely satisfactory sprayer available for small plantings of 1 or 2 acres, which are too large to be sprayed economically with a compressed-air or knapsack hand sprayer (fig. 8).

Figure 8.—Compressed-air sprayer with hose and extension to reach the under side of the leaves.

Some growers have, however, used a barrel sprayer on a wagon bed or a two-wheeled cart for small plantings, arranging a boom and two nozzles to direct the spray to the under surfaces of the leaves. Such an arrangement requires the services of two men and hence is not very economical.

To reach the under surfaces of the leaves, the spray nozzles should be attached to the discharge pipe by a 90° elbow and a 45° elbow, as shown in figure 9. When a power or traction machine is used, it is well to have a third nozzle placed above the row (figs. 10 and 11).

The liquid must be agitated continuously so as to keep the insecticide from settling in the tank sprayer.

A pressure of 150 pounds or more per square inch is necessary to blow the leaves about and insure thorough coverage. Pressure higher than 250 pounds is unnecessary.

New disks should be placed in the nozzles after a total of 10 to 15 hours of spraying. The holes in the disks become enlarged with use, and unless disks are replaced an unnecessary quantity of spray material is used.

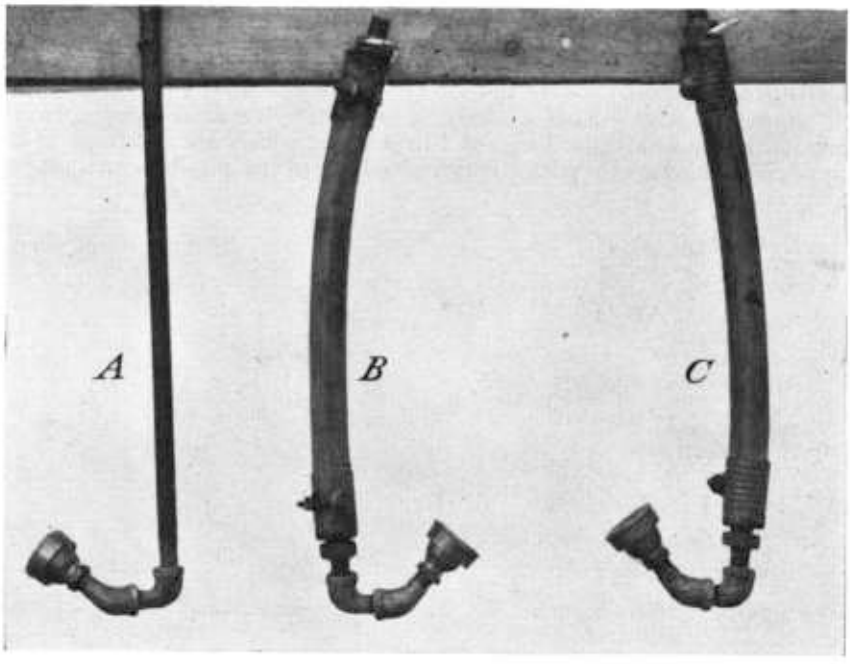

Figure 9.—Arrangement of nozzles necessary to spray the under sides of the leaves: *A*, for hand sprays; *B*, *C*, for power or traction sprayers, with hose sections to prevent breaking pipes.

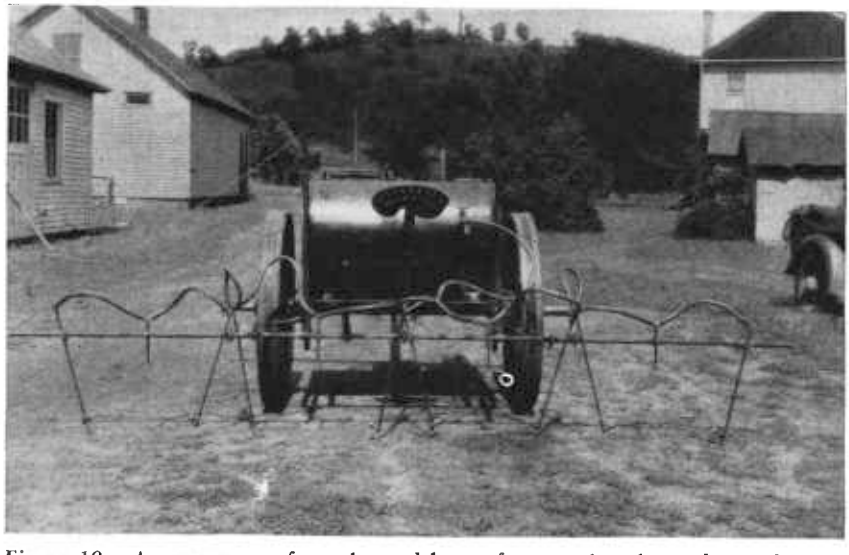

Figure 10.—Arrangement of nozzles and boom for spraying the under surfaces of the leaves. The nozzles are placed on rigid pipes, but the whole boom swings freely.

The boom should be the proper width to suit the width of the rows, and all fields should be planted similarly so that no adjustment of nozzles will be necessary in spraying different fields.

In the case of young beans the boom should be lowered until the nozzles are about 2 inches above the ground. As the plants grow, the boom may be raised accordingly.

On uneven land it is well to have sections of rubber hose in the vertical outlet pipes, so as to make them flexible and thus prevent breaking of the pipes when passing over rough ground (figs. 9 and 11).

Under certain conditions, when a light or spotted infestation occurs on a large planting, it may not be necessary to spray the whole field. In such instances the isolated patches which show beetle or larval injury may be sprayed economically by one man with a

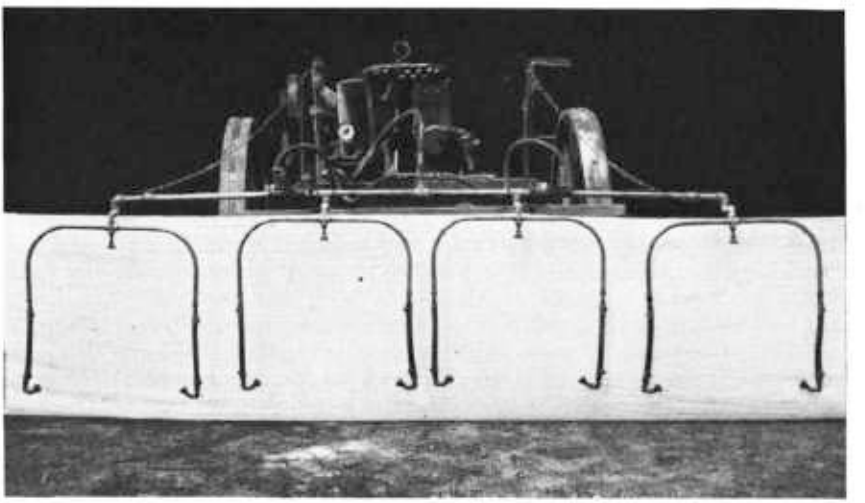

Figure 11.—A series of nozzles attached to a rigid boom. The boom and pipes are protected from breaking by the insertion of sections of rubber hose which bend on striking obstructions or on uneven ground.

3- or 4-gallon compressed-air sprayer. In this manner the infestation may be so reduced as to save later crops from injury. Some growers have practiced this method with success. The nozzle should be arranged so as to spray the under sides of the leaves (fig. 9, *A*).

DUSTS

Rotenone dust for control of the Mexican bean beetle should contain 0.5 to 0.75 percent of rotenone. It may be purchased ready mixed or prepared by diluting ground derris or cube root in pyrophyllite, talc, or sulfur. If derris or cube powder containing 5 percent of rotenone is used, a dust containing 0.5 percent of rotenone may be prepared by mixing 10 pounds of the powder with 90 pounds of diluent, and a dust containing 0.75 percent of rotenone by mixing 15 pounds of the powder with 85 pounds of diluent.

To obtain the amount of root to use for 100 pounds of mixture, divide the desired percentage of rotenone (0.5 to 0.75 percent) by the rotenone content of the root and multiply by 100. Thus, if the ground root

contains 4 percent of rotenone and a dust containing 0.5 percent is desired, the quantity of root to be used is $\frac{0.5}{4} \times 100 = 12.5$ pounds.

Home-prepared dusts may be mixed thoroughly by putting the ingredients in a drum or barrel, not over two-thirds full, together with about a dozen stones as large as the fist, and rolling slowly and tilting at intervals for 5 minutes. Ready-prepared dusts may also be bought.

Sulfur is of value in the control of the two-spotted spider mite,[8] and for the prevention of powdery mildew. It may be used alone as a carrier or in combination with one of the other materials mentioned above in any desired proportion.

In case the bean leaf beetle [9] and the potato leafhopper [10] are present in injurious numbers along with the Mexican bean beetle the addition of 0.1 percent of pyrethrins to the rotenone dust mixture will increase effectiveness. If the corn earworm,[11] the potato leafhopper, the onion thrips,[12] or loopers [13] are present along with the bean beetle, a combination dust mixture containing 3 percent of DDT, 0.5 percent of rotenone, and 50 percent of sulfur in talc or pyrophyllite may be used.

Until further knowledge is gained concerning the possible harmful effects of DDT on humans, no applications of this insecticide should be made on snap beans after the pods have begun to form or on lima beans within 2 weeks of harvest. Nor should bean vines treated with DDT be fed to meat or milk animals.

Although cryolite has not proved to be so effective against the bean beetle as rotenone, good results have been obtained (especially in southeastern districts) with dust mixtures containing from 60 to 80 percent of cryolite in pyrophyllite, talc, or sulfur. Where the corn earworm is present along with the bean beetle, cryolite has proved to be more effective than rotenone for the combined control of the two pests.

Because of the fluorine residue hazard, cryolite should not be applied to snap beans after the pods have begun to form or to lima beans within 2 weeks of harvest.

How to Apply the Dust

The dust should be directed to the under surface of the leaves and should cover as much of the foliage as possible. Enough of the rotenone dust mixture should be applied so that about 2½ pounds of undiluted ground root, calculated on 5-percent rotenone content, is applied to the acre. If a 0.5-percent rotenone content dust is used, this should be applied at the rate of 20 to 25 pounds to the acre (or 1 to 2 ounces on 50 feet of row).

Dusting Machines

A dusting machine of some kind is essential in applying the dust. The easiest and most effective method of applying the dust to small plantings is by use of a hand duster equipped with a bean beetle nozzle

[8] *Tetranychus bimaculatus* Harvey.
[9] *Cerotoma trifurcata* (Forst.)
[10] *Empoasca fabae* (Harr.)
[11] *Heliothis armigera* (Hbn.)
[12] *Thrips tabaci* Lind.
[13] *Pseudoplusia rogationis* Guen.

(figs. 12 and 13). In the home garden a pump-type duster with a nozzle to direct the dust upward is very efficient and economical.

Traction or power machines are available equipped with nozzles (fig. 14) specially constructed to direct the dust to the under surfaces of the leaves. When treating large acreages, especially under adverse weather conditions, better coverage can be obtained with less material by attaching a cloth cover, or apron, 10 to 15 feet long to the duster so that it will drag behind and confine the dust around the plants. *Don't waste insecticides by applying them only to the tops of the leaves.*

Figure 12.—A knapsack bellows duster in use.

Figure 13.—Nozzles for use on dusting machines. The one at the right was made by attaching a grocer's scoop, after removing the handle, to a piece of metal tubing.

Airplane Applications

Within recent years growers in some districts have applied considerable quantities of dusts by airplane. Observations indicate that the present methods of application are not so satisfactory as the use of ground equipment for the control of insects affecting the under sides of leaves.

WHEN TO APPLY TREATMENTS

Begin applications when an average of one beetle or one egg mass is found on two paces (about 6 feet of row), or when beetles are present in sufficient numbers to cause noticeable injury to foliage. To find the beetles give the plant a quick slap with the hand and look on the ground for them. To find the eggs look on the under sides of the leaves.

As the beans grow, the new foliage must be covered with the insecticide; therefore applications should be continued at weekly or

Figure 14.—A four-row tractor-drawn power duster.

10-day intervals, especially if the pest is abundant. Very often three or even four applications are necessary, but as a rule two thorough applications will be sufficient on snap beans. Growers of lima beans for market must protect the crop over a longer period.

Watch fields closely and make applications before damage is done.

WHERE TO GET THE INSECTICIDES

If the insecticides mentioned in this bulletin cannot be obtained from local dealers in agricultural supplies, from local seed stores or general stores, information regarding the nearest source of supply may be obtained from your county agent, State agricultural experiment station, or State department of agriculture.

PLOWING

As important as thorough spraying or dusting is the destruction of the crop remains after picking, especially in the case of snap beans. The fields should be plowed at least 6 inches deep, special effort being made to cover all the bean foliage. Under usual conditions a high percentage of all stages of the insect may be killed when thorough plowing is done.

There is reason to believe that the Mexican bean beetle could be so reduced in numbers by proper destruction of infested bean crops after harvest, over an area the size of an average county, that fewer sprayings or dustings would be required. Benefits derived depend largely on the thoroughness of the disposition of crop remnants.

CULTURAL PRACTICES

The date of planting snap beans to escape injury from the Mexican bean beetle is important in some sections, especially in instances where

it is not necessary to have the crop mature at any certain time. No general rule can be made for all the Eastern States. In some sections beans planted very early escape serious injury. In other sections beans planted at the time when the overwintered adults are disappearing escape serious injury. This is the case in parts of southern Ohio, where beans planted the third week in June often mature without heavy damage because the overwintered beetles have almost disappeared by the time the beans are out of the ground and the beans are blossoming by the time the first brood of new adult beetles are numerous.

COMMUNITY COOPERATION

One of the important sources of infestation is the small garden in towns and settlements. A few untreated rows of beans in a neglected garden are often the breeding ground of many hundreds of beetles, which may spread to commercial acreages in the vicinity. In one locality in Virginia all garden beans in the neighborhood of large plantings are treated cooperatively. Many canners supply insecticides and hand sprayers to small growers at cost and give advice as to their use, and thus contribute to the control of the beetle to the benefit of the whole community. Similar assistance is given in many sections by the farm bureaus in cooperation with the county agents.

SUMMARY OF CONTROL MEASURES

The best control for the Mexican bean beetle is a rotenone spray or dust.

For sprays, derris or cube root powder having a rotenone content of 5 percent should be used at the strength of 1¼ pounds in 50 gallons of water. A powder of a different rotenone content should be used in sufficient quantity to make a spray containing 0.015 percent of rotenone.

Rotenone dusts should contain from 0.5 to 0.75 percent of rotenone. They may be purchased ready-mixed and should be applied at the rate of 20 to 25 pounds per acre.

Applications should be made thoroughly so that the under sides of the leaves are covered by the insecticide. Don't waste insecticides by applying them only to the tops of the leaves.

Applications should be begun when an average of one beetle or one egg mass is found on two paces (about 6 feet of row), or when beetles are present in sufficient numbers to cause noticeable injury to foliage.

One to three, sometimes four, applications are required, depending on the abundance of the insect.

The destruction of crop remains after harvest is as important a control measure as are the thorough applications of dust or spray. Plow under all plant remnants at least 6 inches deep.

Better coverage with dust may be obtained by the use of a light cloth trailer extending about 12 feet to the rear of the duster.

U. S. GOVERNMENT PRINTING OFFICE: 1948

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. - Price 10 cents